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Larch Dwarf Mistletoe Not Found on Alpine Larch

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Reports of larch dwarf mistletoe parasitizing alpine larch are based on two collections of this host/parasite combination made by J.R. Weir in Montana during the early 1900s. Examination of host material from these collections indicates that the host is western larch, not alpine larch as previously reported. Attempts to locate larch dwarf mistletoe on alpine larch were unsuccessful, leaving no valid reports of larch dwarf mistletoe on alpine larch.

Keywords: *Arceuthobium laricis*, *Larix lyallii*, *Larix occidentalis*, hosts

Larch dwarf mistletoe (*Arceuthobium laricis* (Piper) St. John) is a common parasite of western larch (*Larix occidentalis* Nutt.) throughout the range of this commercially valuable conifer (Hawksworth and Wiens 1972). Severely infected trees exhibit reduced growth and are eventually killed by the parasite (Weir 1916, Pierce 1960, Baranyay and Smith 1972). Surveys conducted during the late 1950s found that over 60% of western larch stands in eastern Washington, northern Idaho and western Montana were infested with larch dwarf mistletoe (Graham 1960). Although larch dwarf mistletoe parasitizes several other conifer species, parasitism of these secondary hosts is usually neither severe nor damaging (Hawksworth and Wiens 1972).

Alpine larch (*Larix lyallii* Parl.) occurs at upper timberline in the North Cascades of Washington and extreme southern British Columbia, in the Northern Rocky Mountains of western Montana and northern Idaho, and in the southern Canadian Rocky Mountains of southeastern British Columbia and southwestern Alberta (Arno and Habeck 1972). According to Arno and Habeck (1972), the species ranges from approximately 1500 m (5,000 ft) to 3000 m (9900 ft). Alpine larch generally inhabits cold, rocky sites and is seldom sympatric with western larch. Although the two larch species frequently occur in the same mountain ranges, they are usually separated by 150-300 m (500-1000 ft) of elevation. The different larch species, however, are only rarely found together, for example in areas where alpine larch descends below its normal range by colonizing avalanche chutes, talus slopes, or burned areas. Carlson and Blake (1969) and Carlson et al. (1990) identified several natural hybrid populations in the Bitterroot Mountains of Montana where these species are sympatric.

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Alpine larch has been reported as a secondary host of larch dwarf mistletoe (Gill 1935, Hawksworth and Wiens 1972). These reports were based on only two collections from Montana. These collections were made by J.R. Weir in the early 1900s (Hawksworth and Wiens 1972), and the associated label information is very brief. Weir only described the collection from the Bitterroot Mountains as "near Lolo, Montana" and the collection from the Cabinet Mountains as "region Scotchmans Peak." Because he provided no data on the abundance of infection at the collection sites, the susceptibility of alpine larch to larch dwarf mistletoe could only be tentatively assigned by Hawksworth and Wiens (1972).

To assess the natural susceptibility of alpine larch to larch dwarf mistletoe, we surveyed larch stands in the general locations where Weir reported making his collections: a large population of alpine larch on Carlton Ridge in the Bitterroot Mountains (7 km southwest of Lolo, MT), and a small population on the north-facing slopes of Savage Mountain and East Fork Peak in the Cabinet Range (3 km north of Scotchman Peak and 13 km northeast of Clark Fork, ID). Our extensive surveys of the Carlton Ridge and Savage Mountain locations during 1992 and 1993 failed, however, to locate any dwarf mistletoe infecting alpine larch. Larch dwarf mistletoe populations infecting western larch were located at 1720 m (5500 ft) near Carlton Ridge and at 1590 m (5200 ft) near Savage Mountain. No alpine larches were found near dwarf mistletoe-infected western larches on Carlton Ridge or at the Savage Mountain location.

Although we found no alpine larches that were infected by dwarf mistletoe, the Carlton Ridge population did include a few isolated alpine larch trees with one or two large witches' brooms in the middle or top of the crown. These brooms were, however, not caused by dwarf mistletoe. The general appearance of mistletoe-caused brooms is usually determined by the parasite rather than the host (Hawksworth and Wiens 1972); these brooms did not resemble typical mistletoe brooms on western larch. Because dwarf mistletoe spreads primarily by an explosive fruit, infections (and eventually brooms) tend to occur in clusters and more often in the lower crown; these brooms were isolated and high in the crown. Finally, most dwarf mistletoe infections produce distinctive, aerial shoots; no mistletoe shoots were associated with these brooms. We therefore concluded these brooms were induced by genetic (somatic mutation) or other (unknown) causes as described by Buckland and Kuijt (1957) for alpine larch and other conifers.

We further examined several sites on Carlton Ridge where western and alpine larch are sympatric and hybridize (Carlson et al. 1990). No infection of either host by larch dwarf mistletoe occurred at any of these sites. Lodgepole pine dwarf mistletoe (*Arceuthobium americanum* Nutt.) was present on lodgepole pine (*Pinus contorta* Dougl. ex Loud.) at one site, but no crossover infection to alpine larch was observed. Because western larch is thought to be immune to lodgepole pine dwarf mistletoe (Hawksworth and Wiens 1972), it is unlikely that lodgepole pine dwarf mistletoe would parasitize alpine larch.

In addition to these field surveys, we re-examined Weir's collections to confirm host identification. These specimens (*Weir 8366*, Lolo, MT, 1914 and *Weir 3250*, Scotchman Peak, n.d.) are deposited at the University of Illinois Herbarium, Urbana, Illinois (ILL) and at the USDA Forest Service Forest Pathology Herbarium, Fort Collins, Colorado (FPF). Specimens from these two collections were examined by the first three authors and Steven Arno, USDA Forest Service, Missoula, MT.

Host material from Weir's specimens was compared with herbarium specimens of both western and alpine larch deposited at the USDA Forest Service Herbarium, Missoula, MT (MRC). Larch characters examined included pubescence and bark color of young twigs, and pubescence and color of short shoots (Hitchcock et al. 1973). The collections contained only a few 1- or 2-year-old twigs; those present were glabrous to lightly pubescent rather than tomentose. The several short shoots present were not tomentose but rather resembled those of western larch. Bark color also matched that of western larch of similar age. No ovulate cones were available with Weir's specimens. Because of the lack of tomentose pubescence on this host material and other similarities of the material to western larch (short shoot pubescence and bark color), we concluded that both specimens collected by Weir were western larch. Thus, these specimens do not represent collections of larch dwarf mistletoe on alpine larch.

Even though this identification leaves no valid report of larch dwarf mistletoe parasitizing alpine larch, the species is probably susceptible to larch dwarf mistletoe. Closely related conifer species are frequently parasitized by the same dwarf mistletoe

(Hawksworth and Wiens 1972). Based on artificial inoculations of seedlings, Weir (1918) demonstrated that European larch (*Larix decidua* Mill.) and Japanese larch (*Larix kaempferi* (Lamb.) Carr.) are susceptible to larch dwarf mistletoe. Because alpine and western larch are closely related (Carlson and Blake 1969; Carlson et al. 1990, 1991; Carlson and Theroux 1993), alpine larch is also likely susceptible to larch dwarf mistletoe. Furthermore, larch dwarf mistletoe has a relatively wide host range. As summarized by Hawksworth and Wiens (1972), it commonly parasitizes lodgepole pine, subalpine fir (*Abies lasiocarpa* (Hook.), Nutt.) and mountain hemlock (*Tsuga mertensiana* (Bong.) Carr.). These species are even less closely related to western larch than alpine larch.

Artificial inoculation experiments should be attempted under field conditions to test the susceptibility of alpine larch to larch dwarf mistletoe. Field inoculations on alpine larch would not only provide information on its susceptibility to larch dwarf mistletoe but could also provide information on whether or not larch dwarf mistletoe can successfully reproduce at elevations above its known altitudinal limits.

Larch dwarf mistletoe specimens deposited at FPF have seldom been collected above 1520 m. The only specimens of larch dwarf mistletoe collected above 1520 m are from the Blue Mountains of eastern Oregon at 1980 m (*Hawksworth 981*). The specimens of larch dwarf mistletoe from other states (Washington, Montana, and Idaho) were collected below 1550 m. During our field surveys, however, we found larch dwarf mistletoe as high as 1720 m near Carlton Ridge and 1590 m near Savage Mountain.

Most dwarf mistletoes have elevational limits below that of their principal hosts (Hawksworth 1956, Hawksworth and Wiens 1972, Acciavatti and Weiss 1974, Mathiasen and Hawksworth 1980). Hawksworth (1969) suggested that dwarf mistletoe fruits may not mature at elevations above their natural limits because of short growing seasons. This situation could certainly influence the distribution of larch dwarf mistletoe. Even if alpine larch were susceptible to larch dwarf mistletoe, prevailing climatic conditions in alpine larch stands at high elevations could still prevent larch dwarf mistletoe from reproducing. Nonetheless, if alpine larch were susceptible to larch dwarf mistletoe, then cross-over infections from western larch should occur where both species grow in close proximity (within 10 m). We plan to continue searching for larch dwarf mistletoe where alpine and western larch are sympatric and to proceed with artificial inoculations of larch dwarf mistletoe on alpine larch seedlings and mature trees.

Distinguishing Alpine Larch

Alpine larch is easily distinguished from western larch based on several morphological characteristics (Hitchcock et al. 1973, Carlson et al. 1990, Carlson and Theroux 1993). The most notable characteristics are that young twigs and short shoots of alpine larch are distinctly tomentose, whereas those of western larch are glabrous to slightly pubescent. The leaves of alpine larch are four-angled in cross section, about as thick as broad, and possess two relatively large resin ducts visible in leaf cross sections magnified 25×.

In contrast, leaves of western larch are triangular in cross section, the upper surface almost flat with only a slight ridge, the lower surface ridged in the middle; and they possess small resin ducts visible in cross section (Carlson and Blake 1969). Alpine larch foliage is blue-green and not shiny; western larch foliage is olive-green and shiny. Bark texture and color of 3-year-old branches differs between the species as well: alpine larch bark on 3-year-old branches is gray and rough-textured and bark of western larch is brown and smooth (Carlson et al. 1990).

Other characters that distinguish these species are the morphology of ovulate cones and seed shape (Carlson and Theroux 1993). Alpine larch has ovulate cones from 3.5 to 4.5 cm long; shorter western larch cones are from 2.5 to 3 cm long. Seeds of western larch are narrower, shallower, and have thinner seedcoats than those of alpine larch. Chemical differences (foliar terpenes) also occur between the two species (Carlson et al. 1991).

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